

A REVISION OF THE FAMILY CLAVAGELLIDAE (PELECYPODA, MOLLUSCA) FROM AUSTRALIA, WITH DESCRIPTIONS OF TWO NEW SPECIES

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Plates 10-13

ABSTRACT

There are nine species of the family Clavagellidae recognised from Australian waters, including two new species, *Clavagella* (*Clavagella*) *majrina* sp. nov. an Upper Oligocene fossil from Victoria and Tasmania and *Brechites* (*Foegia*) *veitchi* sp. nov. a living and fossil species from South Australia and Western Australia. A key to the genera and species is given and the three genera and five subgenera are redefined. New information is given on the fossil record and distribution of the species, and the zoogeography of the group is discussed.

INTRODUCTION

This study grew out of a search to identify a member of the family dredged at Port Lincoln, South Australia, which is described herein as a new species. This work revealed the taxonomic confusion in this very unusual bivalve family and the need for a revision of the Australian members. However this revision must be considered as only tentative due to the lack of comprehensive series of specimens and to the total lack of knowledge of the anatomy of many of the species.

The watering-pot shells (Clavagellidae) are highly modified for a sessile mode of life, are usually cryptic in habit, often buried in the substrate, mainly sub-littoral, and therefore only rarely collected. For this reason the geographic distribution of most species is unknown. In addition, the shell structure may show large individual variations due to distorted tube growth in response to objects such as rocks in the environment. The anatomical features of many of the species are unknown, the only good accounts being given for *Clavagella lata* by Owen (1835), *Brechites* species by Lacaze-Duthiers (1870, 1883) and for *Brechites penis* (Linnaeus) by Purchon (1956, 1959). The papers by the latter author also gave the only detailed account of various activities of living specimens of a species of this family.

The family was recently revised by L. A. Smith (1962), though no reasons were given for his placement of the species or for his synonymies. Prior to this the only works of major importance were by Chenu (1843), in which he described many new species, and Gray (1847, 1858a) who proposed a number of generic and sub-generic groupings.

The generic and sub-generic groups suggested by Smith (1962) are retained, as it is felt that anatomical details should be fully considered before statements can be made as to the status of the groups at this level. Likewise, though several named forms have been relegated to synonymy because it was felt that their shell characters fell within the individual

variation of the species, the final elucidation of the species will also have to await more extensive collections and the acquisition of material upon which anatomical studies can be based. Detailed anatomical studies of four species for which material is available will be the subject of a separate paper to be published shortly.

The following abbreviations are used: AM — Australian Museum, Sydney; NMV — National Museum of Victoria; SAM — South Australian Museum; TM — Tasmanian Museum and Art Gallery; WAM — Western Australian Museum.

Family CLAVAGELLIDAE Orbigny, 1844
(= ASPERGILLIDAE Gray, 1858)

Shell nacreous, with one or both valves partially embedded in an elongated calcareous tube; hinge-plate absent; ligament external; tube anteriorly rounded or discoid; smooth, or fringed with simple or branching tubules; or partially closed by a calcareous disc having several pedal foramina.

The family is represented in Australia by nine species contained in three genera and five subgenera. This includes two new species, one recent and one fossil, described herein.

KEY TO THE AUSTRALIAN GENERA, SUBGENERA AND SPECIES.

1. One valve fused with tube. *Clavagella* — 2
1. Both valves fused with tube. — 5
2. (1) Tube with simple siphonal end, with one or more longitudinal ridges, anterior portion free, or attached by anterior end only, with long irregularly shaped, spire-like tubules. *Clavagella* s. str. — 3
2. (1) Tube with simple siphonal end, circular in section, wide with obvious growth rings, anterior end embedded in rock or other hard substrate, with many short tubules around valve. *Clavagella* (*Dacosta*) *australis* (only species in subgenus).
3. (2) Tube multi-angular in section, with 6 or more longitudinal ridges, small, total length less than 3 cm. *Clavagella* (*Clavagella*) *multangularis*.
3. (2) Tube with only one or two longitudinal ridges, large, total length exceeding 3 cm. — 4
4. (3) Anterior portion swollen, hinge anteriorly placed, tubules mainly from side opposite hinge and anterior end. *Clavagella* (*Clavagella*) *torresi*.
4. (3) Anterior portion only slightly wider than tube, hinge slightly anterior of centre of valve, tubules long, from anterior and only in plane of tube. *Clavagella* (*Clavagella*) *majorina* sp. nov.
5. (1) Valves large, forming most of the anterior bag-like cavity, tube angular in section. *Humphreyia strangei* (only species in genus).

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5. (1) Valves small, fused to side of tube, tube circular in section. *Brechites* — 6
6. (5) Siphonal end with a series of plaited ruffles, disc fringe often indistinct, of a series of thick tubules, valves depressed and exposed. *Brechites (Brechites) australis* (only Australian species in subgenus).
6. (5) Siphonal end of tube simple, disc fringed with single row of fine tubules, umbos exposed but valves not depressed and exposed. *Brechites (Penicillus) strangulatus* (only Australian species in subgenus).
6. (5) Siphonal end simple, disc often indistinct and without fringe, umbos almost covered by swollen prominences. *Brechites (Foegia)* — 7
7. (6) Disc small, of a tight cluster of tubules, anterior portion of the tube only slightly bulbous. *Brechites (Foegia) novaezelandiae*.
7. (6) No discrete disc, anterior portion of tube extremely swollen, tubules widely distributed on this portion. *Brechites (Foegia) veitchi* sp. nov.

TAXONOMY

Genus *Clavagella* Lamarck, 1818

Clavagella Lamarck, 1818, *H. N. Anim. sans Vert.*, 5: 430. Type species: *Clavagella echinata* Lamarck 1818 (S.D.: Children, 1823). Synonymy: *Fistulana* Lamarck 1818, *H. N. Anim. sans Vert.*, 5: 432 (no type species found).

One valve fused with the tube, the other remaining free inside the anterior cavity, both adductors persistent in the adult.

Species from two of the four subgenera described for this genus (Smith, 1962) are known from Australia. A species from a third subgenus, *Clavagella (Bryopa) lata* Broderip, 1834, was mentioned as coming from Australia (Smith, 1962) but no direct evidence of this has been found. The original specimen was described from the Cuming Collection and the locality quoted as the Pacific Ocean. This species has been omitted from this revision though future collecting may necessitate its re-instatement in the Australian list.

Subgenus *Clavagella*

Tube free or attached by anterior end only, siphonal end simple, anterior portion with spine-like tubules.

Known only from fossils in Europe and India, and from fossil and recent species in Australia.

Clavagella (Clavagella) multangularis (Tate, 1887)

(Pl. 10, figs. 1, 2, 3)

Aspergillum multangulare Tate, 1887, *Trans. R. Soc. S. Aust.*, 9: 64, pl. 4, 4a - b.

Aspergillum (Humphreyia) liratum Tate, 1887, *Trans. R. Soc. S. Aust.*, 9: 184, pl. 19, fig. 11.

Clavagella multangularis. Tate, 1892, *Trans. R. Soc. S. Aust.*, 15: 134.

Clavagella multangularis. Gabriel, 1908, *Victorian Nat.*, 25: 55.

Clavagella multangularis. Cotton and Godfrey, 1938, *Molluscs of South Australia*, Pelecypoda: 147, fig. 14/.

Clavagella (Clavagella) multangularis. Smith, 1962, *Veliger* 4: 170.

Dacosta multangularis. Macpherson and Gabriel, 1962, *Marine Molluscs of Victoria*: 401, fig. 472.

DIAGNOSIS: Tube small, multi-angular in section, with 6 or more longitudinal ridges and slightly constricted at junction with anterior swollen portion; hinge forming apex of anterior portion; tubules mainly from anterior end, total length less than 3 cm.

TYPE MATERIAL: Holotype of *A. multangularis* in the SAM — D 13172; from Holdfast Bay, St. Vincents Gulf, South Australia. Holotype of *A. liratum* in Tate Museum, Geology Department University of Adelaide, S.A. — T.323; from Adelaide Bore, Kent Town, Adelaide, S.A., Blanche Point Marl, Aldingan (Upper Eocene).

DISTRIBUTION: Upper Eocene to Recent. **FOSSIL:** South Australia: Adelaide Bore, Kent Town, Adelaide; Blanche Point Marl, Aldinga, (Upper Eocene). Victoria: Jan Juc Formation, Janjukian (U. Oligocene), Bird Rock Cliffs, Torquay, Muddy Creek Formation, Balcombian (Miocene), Muddy Creek. **RECENT:** South Australia: St. Francis Island, Great Australian Bight, beach to 200 m. (Cotton 1961); St. Vincent's Gulf and other localities on the southern coast of South Australia and Victoria, from Western Port Bay, Victoria and Bass Strait and Sydney Harbour, N.S.W.

MATERIAL EXAMINED: **FOSSIL:** SOUTH AUSTRALIA: Adelaide Bore, Holotype of *A. liratum* Tate, Tate (Tate Mus., Geol. Dept., Univ. Adel.). VICTORIA: Torquay, J. Dennant Coll., 1 spec. (NMV) Muddy Creek, J. Dennant Coll., 1 spec. (NMV). **RECENT:** SOUTH AUSTRALIA: Holdfast Bay, Tate, Holotype, (SAM); Wallaroo, 27 m, J. Verco, 4 spec. (SAM); St. Francis Is., 64 m, 1 spec., 25 m, 1 spec. J. Verco, (SAM). (Plus many others with no locality). VICTORIA: Western Port Bay, C. J. Gabriel, 3 spec. (NMV); 13.v.1908, C. J. Gabriel, 1 spec. (NMV); Dec. 1905, J. H. Gatliff, 2 spec., (NMV); Bass Strait Cable, 5 spec. (NMV); 72 km S. of Lakes Entrance, 91 m W. S. Ayer, 2 spec., (NMV). NEW SOUTH WALES: Sydney, 2 spec. (AM); 1867, J. Brazier, 2 spec. (AM); 11 m June 1879, J. Brazier, 1 spec., (AM).

ANATOMY: Unknown.

REMARKS: The fossil *A. liratum* Tate is included in the synonymy of this species as it falls within the normal variation of *multangularis*. Tate (1887) states that the two forms differ only in the number of longitudinal ridges on the tube, *liratum* showing many more. However the number of longitudinal ridges in *multangularis* can vary from 6 to 25.

This species lives attached to rocks or dead shells by the disc. Nothing is known of its ecology or behaviour.

Clavagella (Clavagella) torresi Smith, 1885

(Pl. 10, figs. 4, 5.)

Clavagella torresi Smith, 1885. "Challenger" Reports. *Lamellibranchiata*, 13: 28, pl. 8, figs. 1a - b.

DIAGNOSIS: Tube with one or two longitudinal ridges, not constricted at junction with anterior swollen portion, hinge near anterior end of fixed valve; tubules mainly from side of anterior portion of tube opposite hinge and at anterior end.

Clavagellidae

TYPE MATERIAL: The holotype of this species could not be found in a recent extensive search of the collection of the British Museum. The type locality is Torres Strait.

DISTRIBUTION: Recent only. From Torres Strait and the Gulf of Carpentaria in North Queensland to Lindeman Island in Central Queensland.

MATERIAL EXAMINED: QUEENSLAND: Albany Passage, 7 - 26 m. C. Hedley, 5 spec. (AM); Hope Island, 9 - 18 m. C. Hedley, 1 spec., (AM); Lindeman Island, 9 spec. (AM); Port Curtis, 13 m. C. Hedley, 1 spec. (AM), Sweers Island, Gulf of Carpentaria, 14 - 22 m. D. F. McMichael, 9. xii 1962 1 spec. (AM).

ANATOMY: Unknown.

REMARKS: This species was described from a unique specimen which cannot now be found. Consequently the allocation of specimens to this species must remain tentative until the type is located or sufficient material is available to redescribe the species. The specimens from Albany Passage and Lindeman Island all closely resemble the original description.

Clavagella (Clavagella) majorina sp. nov.

(Pl. 10, figs. 6, 7, 8)

DIAGNOSIS: Left valve large, fused with tube, umbo central, valve with concentric striae. Anterior end only slightly swollen, tubules long, arising from the anterior end only; tube wide, oval in section with one slight dorsal ridge, siphonal end simple.

DESCRIPTION: Shell large consisting of a wide, oval tube with a very faint longitudinal ridge and a slightly swollen anterior section, the swelling being more pronounced dorso-ventrally than laterally. Anterior section elongated with the valve close to the junction of the swollen section with the tube. Tubules long, branching and confined to the anterior end. Left valve large, fused with tube, with concentric striae; umbo central; posterior end of valve rectangular; hinge covered by a prominence from the tube.

TYPE MATERIAL: Type series in National Museum of Victoria. Holotype P25943, collected by R. Daintree, 11.vii.1861, and presented by the Geological Survey of Victoria. Dimensions: total length 75.0 mm; max. width 14.0 mm; max. depth 19.5 mm; fused valve length 13.2 mm; valve depth 7.8 mm; length of anterior portion 36.5 mm. Four paratypes; Paratype No. 1, P25944, collected in 1901; dimensions; total length 80.5 mm (broken); max. width 16.5 mm; max. depth 20.3 mm; fused valve length 12.5 mm; valve depth 6.9 mm; length of anterior portion 28.0 mm. Paratype No. 2, P25945, from the F. A. Cudmore Collection; dimensions; total length 54.0 mm (broken); max. width 13.0 mm; max. depth 16.0 mm; fused valve length 13.0 mm; valve depth 9.0 mm; length of anterior portion 29.5 mm. Paratype No. 3, P25946, from the F. A. Cudmore Collection still partially embedded in matrix block set in plaster bed; dimensions; total length 40.5 mm; max. width 7.0 mm; max. depth indeterminable; fused valve length 10.5 mm; valve depth indeterminable; length of anterior portion 21.0 mm. Paratype No. 4, P17175, collected by F. S. Colliver, still partially embedded in matrix; dimensions; total length 81.0 mm; max. width 11.0 mm; max. depth indeterminable; fused valve length 9.5 mm; valve depth 6.0 mm; length of anterior portion 23.0 mm.



Clavagellidae

TYPE LOCALITY: Bird Rock Cliffs, near Torquay, Victoria, Grid Ref. Anglesea 378,704 Jan Juc For., Janjukian, Upper Oligocene.

DISTRIBUTION: Upper Oligocene only. Type locality and Table Cape, Tasmania.

MATERIAL EXAMINED: VICTORIA: Type locality, type series, topotypes (10 spec.) Cudmore Colln. (NMV), topotypes (6 spec.) R. Daintree 1861 (NMV). TASMANIA: Fossil Bluffs Sandstone, upper beds Table Cape, F. A. Cudmore Colln., 1 spec. partially embedded in matrix. (NMV).

REMARKS: This species is closely similar to *Clavagella (Clavagella) torresi* Smith from the warmer waters of northern and eastern Australia. It differs from *torresi* mainly in its larger maximum size, both in length and width; in the relative sizes of the tubes and anterior portions; in the position of the valve and hinge and in the distribution of the tubules. In *C. (C) torresi* the anterior portion is much more swollen relative to the diameter of the tube, the hinge is situated well towards the anterior end of the valve while in *majorina* it is more centrally placed. In addition, the tubules of *torresi* arise from the ventral side of the anterior portion as well as the anterior end instead of being confined to the anterior end as in *majorina*. It is easily separated from *C. (C.) multangularis*, the only other Australian species in this subgenus, by its much larger size and by having only one or two indistinct longitudinal ridges instead of six or more. Comparison was also made between this species and the other members of the subgenus listed by Smith (1962) all of which are European fossils, with one exception from India. All the European species are distinguished by their small size, their relatively large valves in comparison to total size and the presence of tubules in regions other than the anterior end. The Indian species, *Clavagella semiculcata* Forbes 1846, is close to *C. (C) majorina* in size but differs in having the umbo placed anteriorly on the valves instead of near the centre. In addition the posterior ends of the valves of *semiculcata* are rounded, whereas those of *majorina* are rectangular.

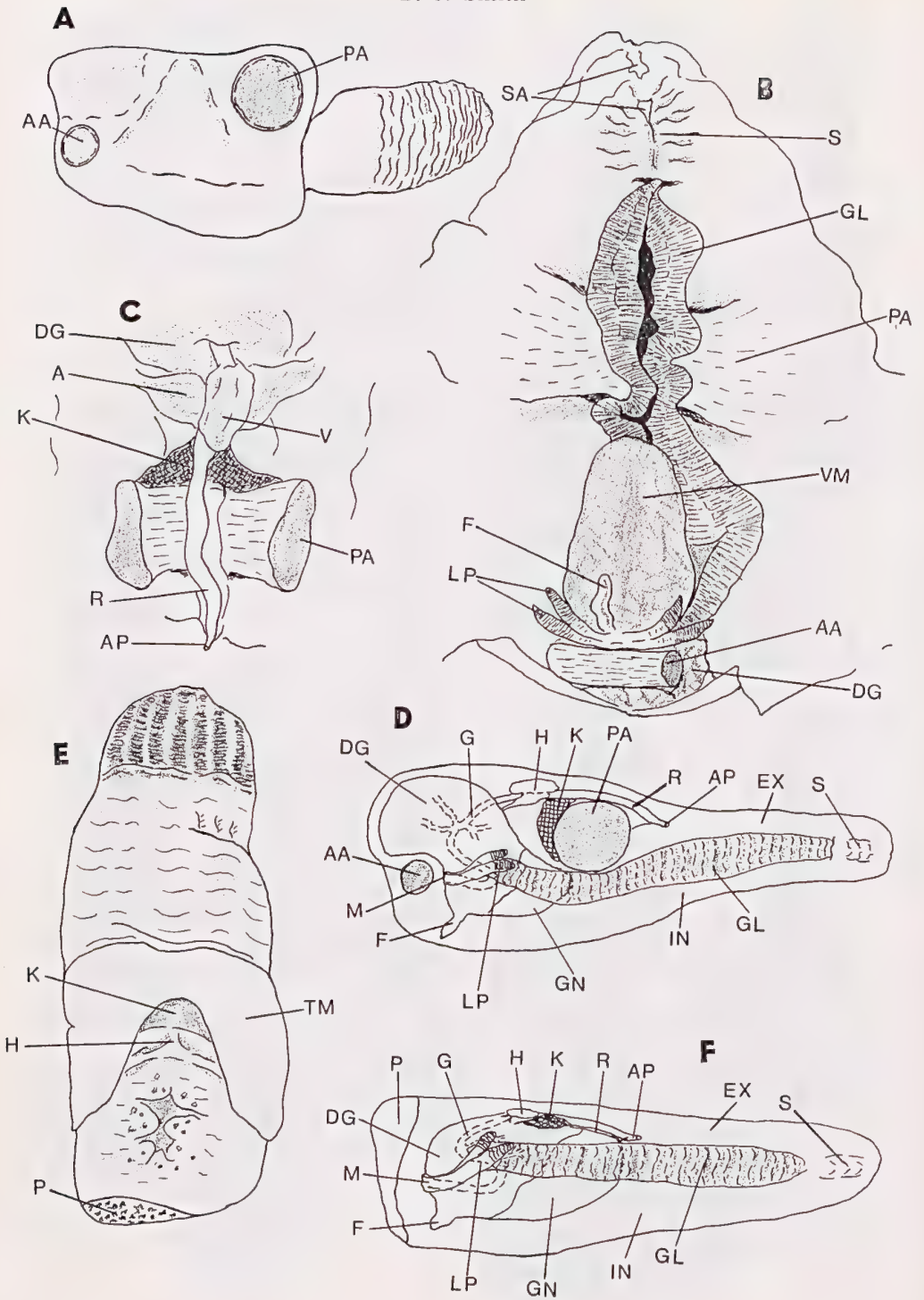
The presence of members of this subgenus in the Oligocene fauna of southern Australia necessitate minor alterations in Smith's (1962) historical zoogeographical theories for the family. This will be discussed below.

Clavagella (Clavagella) sp?

There are several fossil specimens referable to this subgenus in the collections of the National Museum of Victoria from Bird Rock Cliffs, Victoria and Table Cape, Tasmania. These will have to remain undetermined for the present due to their imperfect preservation or broken condition.

PLATE 10

- Fig. 1-2. *Clavagella (Clavagella) multangularis* (Tate), D13172, holotype, Holdfast Bay, St. Vincents Gulf, South Australia. (SAM).
- Fig. 3. *Clavagella (Clavagella) multangularis*, T323, holotype of *Aspergillum (Humphreyia) liratum* Tate, Adelaide Bore, Kent Town, Adelaide, South Australia. (Geol. Dep. U. of Adel.).
- Fig. 4. *Clavagella (Clavagella) torresi* Smith, C36152, Albany Passage, Torres Strait. (AM).
- Fig. 5. *Clavagella (Clavagella) torresi*, C58817, Lindeman Is., Queensland, (AM).
- Fig. 6-7. *Clavagella (Clavagella) majorina* sp. nov., P25943, holotype, Bird Rock Cliffs, Torquay, Victoria, (NMV).
- Fig. 8. *Clavagella (Clavagella) majorina* sp. nov., P25944, paratype. (NMV).
- Fig. 9-10. *Clavagella (Dacosta) australis* (Sowerby), Sydney Harbour, N.S.W. showing interior of iree valve. (AM).



Clavagellidae

Subgenus *Dacosta* Gray, 1858

Dacosta Gray, 1858, *Proc. Zool. Soc. Lond.* 26: 315. Type species: *Clavagella australis* Sowerby, 1829, (Monotypy).

Siphonal end simple, tube circular in section, wide, with obvious growth rings and many short tubules around valve. Anterior end usually embedded in rock or other hard substrate.

This sub-genus contains only one species.

Clavagella (Dacosta) australis (Sowerby, 1829)

(Pl. 10, figs. 9, 10)

- Clavagella australis* Sowerby, c. 1827 - 1829. *Stutchbury Catal.* app. :3.
Clavagella elongata Broderip, 1834, *Proc. Zool. Soc. Lond.* for 1834 :116.
Clavagella elongata. Broderip, 1835, *Trans. Zool. Soc. Lond.* 1: 265, pl. 35, figs. 1 - 4.
Dacosta australis. Gray, 1858, *Proc. Zool. Soc. Lond.* for 1858 : 315.
Clavagella australis. Reeve, 1872, *Conch. Icon.* 18, *Clavagella* pl. 2, figs. 4a - d.
Clavagella (Dacosta) australis. Tryon, 1884, *Struc. and Syst. Conch.* 3 : 119.
Clavagella australis. Pritchard and Gatliff, 1903, *Proc. R. Soc. Vict.* 16: 96.
Dacosta australis. Hedley, 1917, *Proc. R. Soc. N.S.W.*, 51 : M 14.
Clavagella (Dacosta) australis. Smith, 1962, *Veliger*, 4: 171.
Dacosta australis. Macpherson and Gabriel, 1962, *Marine Molluscs of Victoria*: 401, fig. 471.

DIAGNOSIS: As for sub-genus above.

TYPE MATERIAL: No type material of *C. australis* or *C. elongata* could be located in the British Museum and their location is unknown. The type locality is Sydney Harbour, N.S.W.

DISTRIBUTION: Recent only. From Sydney Harbour and Merimbula, N.S.W. and Lord Howe Island with two very doubtful records from Victoria.

MATERIAL EXAMINED: NEW SOUTH WALES: Sydney Harbour. 2 spec. (used for dissection) (AM); H. Cuming, 2 spec. (NMV); Petterd, 1873, 1 spec. (NMV); C. J. Gabriel, 5 spec. (NMV); H. Edwards, 1860, 5 spec., (NMV), J. C. Cox; 9 spec. (SAM). Merimbula, W. F. Ponder and P. H. Colman, 1970, 2 spec. (used for dissection) (AM). Lord Howe Island. 1 spec., (Old Coll. — AM). VICTORIA: Corio Bay, Tate, 1 spec., (SAM).

ANATOMICAL NOTES: (Text figs. A - D). Four specimens with the soft parts preserved, were made available by the Australian Museum for this study; two from Sydney Harbour and two from Merimbula, N.S.W. A full description of the anatomy will be published as a future paper.

The animal is weakly attached to the shell at the hinge and there seems to be little or no attachment of the adductor muscles to the shells. The body is completely enclosed in a thin, almost transparent, brown mantle, the opening to the pallial cavity being reduced to a small slit in the mid-

TEXT Fig. A - F.

- A. Diagram of the lateral view of the exterior of the animal of *Clavagella (Dacosta) australis*, showing the positions of the two adductor muscles.
- B. Diagram of the interior of the pallial chamber of *Clavagella (Dacosta) australis* from the ventral side.
- C. Diagram of the heart, kidney and hind-gut region of *Clavagella (Dacosta) australis* from the dorsal side.
- D. Diagrammatic representation of the gross anatomy of *Clavagella (Dacosta) australis* from the lateral view.
- E. Diagram of the dorsal view of the exterior of the animal of *Humphreyia strangei*.
- F. Diagrammatic representation of the gross anatomy of *Humphreyia strangei* from the lateral view.

ventral region. The body is projected posteriorly (Text fig. A) into a contractile prolongation which, in life, projects up the tube and into the water. As this prolongation contains the gills for much of its length, it cannot be termed the siphons, but must be considered part of the body. It terminates posteriorly in two short separate fused siphons, each surrounded by a number of fleshy lobes or papillae. Both adductor muscles persist as easily recognisable structures in the adult, the posterior adductor being approximately twice the size of the anterior.

The pallial cavity is almost filled by the viscero-pedal mass which is an egg-shaped structure flattened anteriorly and slightly compressed laterally (Text fig. B). The foot is a small, laterally flattened, finger-like projection at the anterior end of the visceral mass and is approximately a quarter its length. The mouth, which is situated between the foot and the anterior adductor muscle, is margined by two labial flaps which project laterally and dorsally into well developed pairs of labial palps. These are divided into many filaments soon after they leave the mouth and extend laterally to the dorsal wall of the pallial cavity where they enclose the anterior end of the gills. The gills start level with the foot at the dorso-lateral junction of the visceral mass. Each gill is composed of many V-shaped filaments attached to the pallial wall along the centre of the V. They fuse at the posterior end of the visceral mass to form a W-shaped double filament structure which extends practically to the posterior end

of the body projection forming a complete horizontal, median barrier in this section of the body separating the in-current (ventral) from the ex-current (dorsal) chambers. Posterior to the gills, the two short siphons run to the exterior. The gills are ventral to the posterior adductor muscle and the rectum passes dorsal to it, opening by a short anal papilla on the postero-dorsal end of the visceral mass. The large red heart consists of a large ventricle on the dorsal surface of the rectum and lateral auricular lobes on either side of the rectum anterior to the posterior adductor (Text fig. C). The brown kidney is ventral to the rectum closely associated with the anterior side of the posterior adductor. The visceral mass is composed of at least two easily separable glandular portions as well as the gut. The intestine appears to be short with little coiling; stomach inconspicuous with several branching ducts going to the brown, soft, alveolar-like digestive gland which occupies the anterior portion of the visceral mass. This gland also extends dorsally around the anterior adductor muscle and forms a pad of tissue occupying the anterior portion of the body. This pad of tissue occupies the region of the tube which bears perforations in the form of tubules, the function of which is not yet understood. The posterior part of the visceral mass contains the gonads. The details of the alimentary, circulatory, renal, nervous and reproductive systems will be described elsewhere.

REMARKS: *C. elongata* Broderip is relegated to synonymy because, from the description, no difference between it and *C. australis* could be found. Its locality of Pacific Ocean is also very unsatisfactory. Until more specimens of this unusual species are discovered in localities other than Sydney Harbour, the species variation and its distribution must remain unknown. Macpherson and Gabriel, 1962, list it as a Victoria species but state that it has only been recorded once and that the exact locality is unknown. This specimen could not be found in the National Museum collections. A specimen in the South Australian Museum, from the Tate Collection, is

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recorded as being from Corio Bay, Victoria. However, there is no other evidence to support this, even though two extensive faunal surveys have been carried out in the area in the last 80 years with a great deal of collecting. Therefore, until more specimens are found, the occurrence of this species in Victoria must be suspect.

Two specimens of this species recently collected from Merimbula, N.S.W. were found on the edge of an overhang on a large rock just above low tide. The tubular part was projecting vertically from the surface of the rock (at an angle of 45° approx.) on its sheltered side among short algae. A specimen in a similar habitat was collected from Long Reef, near Sydney, by Mr. P. H. Colman. This specimen was loosely attached to a rock on the southern side of the reef at extreme low water level in a pool (W. F. Ponder — pers. comm.).

Genus *Humphreyia* Gray, 1858

Humphreyia Gray, 1858, *Proc. Zool. Soc. Lond.*, 26: 317. Type species: *Aspergillum strangei* A. Adams, 1852 (Monotypy).

Tube angular in section, valves large, fused to the tube in a single plate forming most of anterior bag-like cavity.

This genus is known only from south-eastern Australia.

Humphreyia strangei (A. Adams, 1852)

(Pl. 11, figs. 11, 12)

- Aspergillum strangei* Adams, 1852. *Proc. Zool. Soc. Lond.* 20: 91, pl. 15, fig. 5.
Brechites (Fogia) strangei. H. Adams and A. Adams, 1858, *Genera of Recent Molluscs*, 2: 339.
Humphreyia strangei. Gray, 1858, *Proc. Zool. Soc. Lond.* 26: 317, figs. 1-2.
Humphreyia strangei. Gray, 1858, *Ann. Mag. N. Hist.* 3rd series, 2 (7): 16, figs. 1-2.
Aspergillum strangei. Reeve, 1860, *Conch. Icon.*, 12 (*Aspergillum*) pl. 2, fig. 4.
Humphreyia coxi Brazier 1872. *Proc. Zool. Soc. Lond.* for 1872: 22, pl. 4, fig. 10a-b.
Humphreyia strangei. Tenison-Woods, 1878 Pap. *Proc. R. Soc. Tas.* for 1877: 47.
Aspergillum (Humphreyia) strangei. Tryon, 1884, *Struct. and Syst. Conch.*, 3: 118.
Humphreyia strangei. Pritchard and Gatliff, 1903, *Proc. R. Soc. Vict.* 16: 97.
Humphreyia strangei. Smith, 1910, *Proc. Malac. Soc. Lond.*, 9: 23.
Humphreyia strangei. Cotton and Godfrey, 1938, *Molluscs of South Australia (Pelecypoda)*: 148, figs. 145-6.
Humphreyia strangei. Ludbrook, 1955, *Trans. R. Soc. S. Aust.* 78: 37.
Humphreyia strangei. Smith, 1962, *Veliger*, 4: 171.
Humphreyia coxi. Smith, 1962, *Veliger*, 4: 171.
Humphreyia strangei. Macpherson and Gabriel 1962, *Marine Molluscs of Victoria*: 403, fig. 473.

DIAGNOSIS: As for genus above.

TYPE MATERIAL: Lectotype, here designated, in British Museum BM(NH) 1968667. Length 123 mm. Type locality, Sydney Harbour, N.S.W. One paralectotype, BM(NH) Reg. No. 1969261.

DISTRIBUTION: Pliocene to Recent. **FOSSIL:** From Abattoirs Bore, Dry Creek Sands, South Australia. (Ludbrook, 1955).

RECENT: From central New South Wales and Sydney Harbour to Victoria and the north coast of Tasmania to South Australia in Spencer and St. Vincents Gulfs and the Great Australian Bight. Cotton (1961) also records it from south-west Western Australia.

MATERIAL EXAMINED: NEW SOUTH WALES: Sydney Harbour, Capt. Comtesse, 1 spec., J. C. Cox, 4 spec., (SAM); J. H. Gatliff, 2 spec.,

Clavagellidae

(NMV). Port Stephens, Nov. 1874, Hargreaves, 1 spec. (NMV); 3 spec. (AM). Port Jackson, Capt. Comtesse, 4 spec. (AM). VICTORIA: Warrnambool, 15.ii.1913, Clarke, 1 spec., (NMV). Western Port Bay, 3.vi.1968, B. J. Smith, 1 spec. (animal preserved for dissection) (NMV); J. H. Gatliff, 6 spec., (NMV); 18.viii.1933, J. Segrave, 3 spec., (NMV); 13.v.1908, C. J. Gabriel, 1 spec. (NMV). TASMANIA: Burnie, March, 1946, H. Somerset, 3 spec., (TM). Blyth, Dec. 1945, H. Somerset, 2 spec., (TM). Clarke Is., 1 spec., (NMV). Killisrankie Bay, Flinders Is., J. A. Kershaw, 1 spec., (NMV). SOUTH AUSTRALIA: Backstairs Passage, J. C. Verco, 2 spec., (SAM). Beachport, 200m. J. C. Verco, 1 spec., (SAM). Corny Point, Yorke Peninsular, R. Anderson, 1 spec. (Anderson Coll. — Adelaide). Edithburg, J. C. Verco, 16 spec., (SAM). St. Vincent's Gulf, 1 spec. (AM).

ANATOMICAL NOTES: (Text figs. E - F). A single specimen dredged by the author in 7 m. off Stony Point, Western Port Bay, Victoria on 3.vi.1968 and preserved in 70% alcohol.

The animals appear to have little or no attachment to the shell. The body is enclosed in a thick muscular outer investment except for the mid-dorsal region which is covered by a thin transparent membrane through which the heart can be seen. There are two semi-circular smooth patches of body wall on the sides of the anterior part of the body corresponding to the true mantle. The body is elongated posteriorly into a thick muscular contractile prolongation with the two siphons opening by separate apertures from its posterior end (Text fig. E).

The internal anatomy of this species is similar in most respects to that of *Clavagella (Dacosta) australis* described above. The main difference is the absence of the anterior adductor muscle in at least the adult and the probable reduction of the posterior adductor muscle to a non-functional vestige. A small piece of brown tissue on the dorsal surface of the kidney was tentatively identified as this structure because it was situated in the correct position, but confirmation of this identification will have to await histological examination. This species also differs in having the digestive gland confined to the visceral mass. The body wall anterior to the visceral mass is thick and muscular. The significance of this thickening and its relationships to the perforations in the shell are not understood.

As in the previously described species the gills commence as two V-shaped filamentous demibranchs attached to the latero-dorsal walls of the visceral mass. Posterior to the visceral mass they fuse and extend up the posterior prolongation of the body dividing it into in-current and ex-current chambers. A pair of labial palps extend from folds on either side of the mouth and overlap the gills. The foot is reduced to a small knob of tissue on the antero-ventral apex of the visceral mass.

REMARKS: *Humphreyia coxi* Brazier 1872 is included in the synonymy of this species because it falls within the specific variation of *H. strangei* and it occurs within the range of the latter species. It was originally separated because several specimens were found from Port Stephens with greatly swollen anterior ends. However, this is most likely only a local variation in which the anterior end is enlarged.

The type specimen of *H. coxi* could not be located in the Australian, British or MacLay Museums.

Clavagellidae

Genus *Brechites* Guettard, 1770

Brechites Guettard, 1770, *Mem. diff. Sci.*, 3: 154. Type species: *Aspergillum vaginiferum* Lamarck, 1818. (S.D.: Stoliczka, 1871).

Synonymy: *Verpa* Roding, 1793, *Mus. Boten.* 2: 69. Type: *Serpula penis* Linne (Monotypy).
Aquaria Perry, 1811, *Conchology*, pl. 52. Type: (none found).
Arytena Oken, 1815, *Lehrb. Nat.* 3 (1), XIV: 379 (rejected ICZN 1956).
Clepsydra Schumacher, 1817, *Ess. Vers. test.*, 79: 261.
Aspergillum Lamarck, 1818, *H. N. Anim. sans. Vert.*, 5: 429.
Warnea Gray, 1858, *Proc. Zool. Soc. Lond.*, 26: 310.

Both valves fused with tube, valves small, tube circular in section.

In his revision of the family, Smith (1962) discarded this generic name, declaring Guettard 1770 to be non-binomial and therefore invalid, and put forward *Penicillus* Bruguiere as the valid name. However I have been able to find no evidence to support the contention that Guettard is to be regarded as non-binomial. On the contrary, in a personal communication from the Science Museum Library, South Kensington, London, the following opinion was given by a staff member of the British Museum (Natural History) and a member of the International Commission of Zoological Nomenclature.

“Guettard, in this work (*Mem. diff. Sci.*), gives acceptable generic names. His species are given only vernacular names. He may therefore be considered binominal. Any Latin specific names, polynominal or binominal, are only quoted from other authors, and are not ‘adopted’ by Guettard.”

Other generic names erected by Guettard (1770) in the same publication have been considered valid by other authors; for example Turner (1966) considered *Kuphus* Guettard 1770 and *Uperotus* Guettard 1770 to be valid. The genus *Brechites* was also considered valid by Purchon (1956). Prior to this the genus was used by Adams (1858), Stoliczka (1871), Fischer (1887), Nomura (1933), Korobkov (1954) and Shikama (1954). There are, therefore, precedents both for the use of generic names from the Guettard 1770 publication, and for the continued use of *Brechites*. *Penicillus* therefore must be relegated to the synonymy of *Brechites*.

Species from three of the four subgenera described for the genus are found in Australian waters. The recent species of this genus are all confined to the Indo-Pacific region where they are known from the Red Sea and from Japan to Australia.

Until more material becomes available it seems better to retain the sub-generic groups of Smith (1962) than to elevate them to full genera. However because of the validation of *Brechites* and the discovery of a type species for this taxon, the sub-generic names differ from those listed by Smith (1962). Stoliczka (1871) designated *Aspergillum vaginiferum* Lamarck, 1818 as the type species for *Brechites* s.str. and as this appears to be the earliest type designation for the taxon, this relegates *Warnea* Gray, 1858 into its synonymy. However, the species *A. strangulatum* Chenu, 1843 does not fit into this group and *Penicillus* Bruguiere, 1789 can be used to accommodate it, thus causing *Clepsydra* Schumacher, 1817 to fall into its absolute synonymy.

Subgenus *Brechites*

Synonym: *Warnea* Gray, 1858.

Siphonal end with a series of plaited ruffles, disc fringe, often indistinct, of a series of thick tubules, valves depressed and exposed.

Brechites (Brechites) australis (Chenu, 1843)

(Pl. 11, figs. 14, 15, 16, 17)

- Aspergillum australe* Chenu, 1843. *Illus. Conch.*, 1, *Aspergillum*: 3, pl. 3, fig. 1, 1a.
Aspergillum cumingianum Chenu, 1843. *Illus. Conch.*, 1, *Aspergillum*: 3, pl. 3, figs. 4, 4a.
Aspergillum incertum Chenu, 1843. *Illus. Conch.*, 1, *Aspergillum*: 4, pl. 4, figs. 5, 5a, 6, 6a.
Brechites australis. H. Adams and A. Adams, 1853. *Genera of Recent Mollusca*, 2: 339.
Brechites (Foegia) cumingianus. H. Adams and A. Adams, 1858. *Genera of Recent Mollusca*, 2: 339.
Brechites (Foegia) incertus. H. Adams and A. Adams, 1858. *Genera of Recent Mollusca*, 2: 339.
Warnea australis. Gray, 1858. *Proc. Zool. Soc. Lond.* 26: 310.
Aspergillum cumingianum. Reeve, 1860. *Cinch. Icon.*, 12, *Aspergillum*, pl. 2, fig. 7a - b.
Aspergillum incertum. Reeve, 1860. *Conch. Icon.*, 12, *Aspergillum*, pl. 4, fig. 19.
Penicillus (Foegia) cumingianus. Smith, 1962, *Veliger*, 4: 173.
Penicillus (Warnea) australis. Smith, 1962, *Veliger*, 4: 174.

DIAGNOSIS: Valves, small and exposed, depression surrounding valves ovoid, symmetrical; disc tubules many, small, anterior portion of tube slightly swollen, plaited ruffles small.

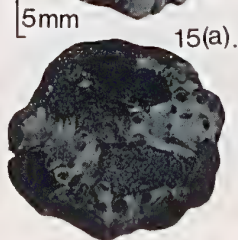
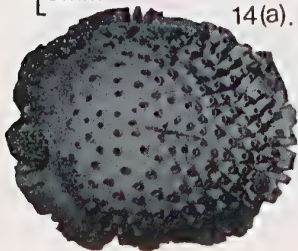
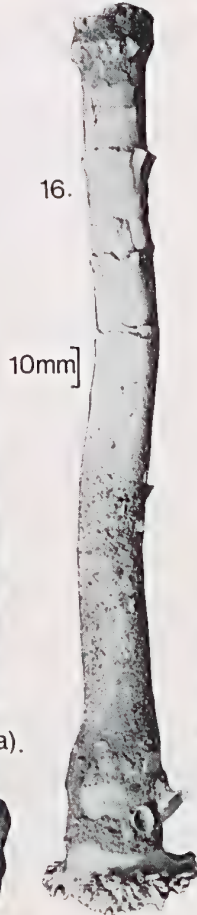
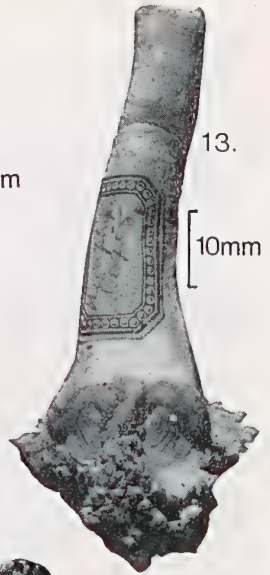
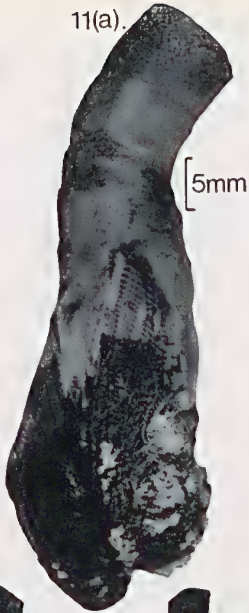
TYPE MATERIAL: Type specimens of *A. australis* and *A. cumingianum* could not be found in the British Museum and their locations are not known. Two syntypes of *A. incertum* are in the British Museum BM (NH) 1968669/70. The type localities for *A. australis* and *A. cumingianum* are given as Australian seas while that for *A. incertum* is given as Swan River, New Zealand. This is certainly a mistake for Western Australia.

DISTRIBUTION: Lower Pleistocene to Recent. **FOSSIL:** Roe Plains, 53 km E. of Madura, Western Australia. **RECENT:** North-west Western Australia from Yampi Sound to Exmouth Gulf and one specimen from the eastern end of the Great Australian Bight in South Australia.

MATERIAL EXAMINED: **FOSSIL:** WESTERN AUSTRALIA: Roe Plain, Hampton Microwave Tower, 53 km E. of Madura, 6 km S. of Eyre Highway, 127° 34'45" E., 31° 57'57" S., Grid Ref. Eucla 563045, T. A. Darragh, 21.iv.1969, 2 spec. (NMV). **RECENT:** WESTERN AUSTRALIA: Barrow Is., 20.ix.1966, WAM-USNM Barrow I. W.A. Exp. 1966, 20° 52'S 115° 19'E, sheltered intertidal sand and mud flats, 3 spec. (in spirit) (WAM); June 1964, W. H. Butler, 1 spec. (in spirit) (WAM); 18.ix.1958, R. W. George, 1 spec. (WAM). Roebourne, Sept. 1959, L. Marsh, 1 spec. (in spirit) (WAM). Bay of Rest, Exmouth Gulf, July 1966, B. R. Wilson, 1 spec. (in spirit) (WAM). Cockatoo Is. 1 spec. (in spirit) (NMV). Yampi Sound, 1958, G. A. Robinson, 2 spec. (WAM). Sandy Is., Mary Ann Passage, 17.ix.1958, R. W. George, 1 spec. (WAM). Port Simpson, 1956, J. Balluci

PLATE 11

- Fig. 11. *Humphreyia strangei* (A. Adams), BM(NH) 1968667, lectotype, Sydney Harbour, N.S.W. (a) back of shell showing the remains of the shell to which the specimen was attached.
 Fig. 12. *Humphreyia strangei*, F22283, Phillip Is., Victoria showing irregular tube growth (NMV).
 Fig. 13. *Humphreyia strangei*, F27421, Port Stephens, N.S.W. (NMV).
 Fig. 14. *Brechites (Brechites) australis* (Chenu), BM(NH) 1968669, syntype of *Aspergillum incertum* Chenu, Swan River, Western Australia; (a) top view of disc.
 Fig. 15. *Brechites (Brechites) australis* BM(NH) 1968670, syntype of *Aspergillum incertum*; (a) top view of disc.
 Fig. 16. *Brechites (Brechites) australis*, 5053-68, Broome, Western Australia, showing ruffles at the end of the tube (WAM).
 Fig. 17. *Brechites (Brechites) australis*, F27462, Point Sinclair, South Australia, (NMV).



and B. R. Wilson, 1 spec. (WAM). Broome, B. Bardwell, 4 spec. (NMV). SOUTH AUSTRALIA: Point Sinclair, Neeves, 1 spec. (NMV).

ANATOMICAL NOTES: (Text figs. G - H). Preserved specimens from Broome were available in the NMV and WAM. The animal is large with a thin mantle surrounding the anterior part of the body. A thick, muscular, contractile posterior portion terminates with fused siphons. There is a small pore on the mid ventral line approximately level with the heart. This is the vestige of the opening to the pallial cavity. The anterior end consists of a flat pad of spongy tissue with small contracted processes projecting from its surface. This remains in close contact with the inside of the disc and the processes in life probably form filaments which protrude through the perforations in the disc. The function of these filaments is not known. There is a small nearly transparent area mid-dorsally in the hinge region through which the heart can be seen.

Internally the anatomy is essentially similar to *Clavagella (Dacosta) australis* except for the total absence of both adductor muscles. The visceral mass is large and the foot appears as a long, flattened, finger-like projection from its anterior end. The labial palps are long and consist of many filaments. The gills too are long and extend almost the full length of the body. The filaments are large and almost fill the branchial cavity dividing it into in-current and ex-current chambers.

REMARKS: This species is subject to a high degree of individual variation, a reflection of the substrate into which the animal was burrowing, either causing curvature of the tube or adhering to the disc causing gross distortion in this area. This is most probably the cause of the different forms which led Chenu (1843) into erecting the three species that are here synonymized. The name *australe* is used as it has page preference.

It is interesting to note that these occur intertidally in some localities where they were observed with the siphonal ends of the tubes protruding vertically out of the mud and sand and the anterior end permanently buried.

The one specimen found from the eastern end of the Great Australian Bight has a more delicate structure with finer anterior tubules but is undoubtedly referable to this species. This specimen was found alive embedded in a kelp root exposed by a very low tide. It was discovered because the collector saw it squirting water out of the siphon.

The two fossil specimens collected from the Lower Pleistocene deposits of the Roe Plain, Western Australia record this species as a fossil for the first time. The associated fauna appears to have Indo-Pacific affinities with some warm water representatives while others (like this species) still live in the Bight. (T. A. Darragh — pers. comm.).

Subgenus *Penicillus* Bruguiere, 1789

Penicillus Bruguiere, 1789, *Ency. Method. (Vers)*, 1: 126. Type species: *Serpula aquaria* Burrow, 1815 = *Serpula penis*, Linnaeus, 1758: (S.D. — Stoliczka, 1871).
Synonym: *Clepsydra* Schumacher, 1817.

Siphonal end of tube simple, disc fringed with single row of tubules, umbos exposed but valves not depressed and exposed.

Clavagellidae

Brechites (Penicillus) strangulatus (Chenu, 1843)

(Pl. 12, figs. 18, 19)

Aspergillum strangulatum Chenu, 1843. *Illus. Conch.*, 1, *Aspergillum*: 3, pl. 2, figs. 4 - 4a.
Brechites strangulatus. H. Adams and A. Adams, 1858, *Genera of Recent Mollusca*, 2: 339.
Clepsydra strangulata. Gray, 1858, *Proc. Zool. Soc. Lond.* 26: 313.
Aspergillum (Clepsydra) strangulatum. Tryon, 1884, *Struc. and Syst. Conch.*, 3: 118.
Penicillus (Penicillus) strangulatus. Smith 1962, *Veliger*, 4: 172.

DIAGNOSIS: Tube constructed into a "neck" region immediately behind disc, aperture in figure 8 form.

TYPE MATERIAL: Holotype in the British Museum, BM (NH) 1841 10.12. 38; from Port Essington, N.S.W. This is certain to be Port Essington, Coburg Peninsular, Northern Territory.

DISTRIBUTION: Recent only. Extends from Central Queensland round the north coast of Australia to Rottnest Island in southern Western Australia.

MATERIAL EXAMINED: QUEENSLAND: Albany Island, 7 - 25 m, C. Hedley, 1 spec., (AM). Bowen, T. Hartley, 17 spec., (NMV). Cape York Peninsular, T. A. Garrard, 4 spec., (AM). Crab Island, E. Jensen, 7 spec., (AM). C. D. George, 2 spec., (AM). Port Denison, Nov. 1874, W. H. Hargraves, 1 spec., (NMV). Torres Strait, Elliott, 12 spec., (SAM). NORTH-EASTERN TERRITORY: Cape Bedwell, 11.vi.1938, 14 - 16 m., 2 spec., (AM). WESTERN AUSTRALIA: West of Rottnest Island, 16.ix.1965, "Bluefin", 146 m, 1 spec. (disc only), 128 m (sand), 2 spec. (discs only), (WAM). 241 km ENE Troughton Island, 23.x.1962, 91 m (mud), 2 spec. (discs only), (WAM). 27°18' S. 113°16' E.N.W. of Bluff Pt., CSIRO St. 204, 9. x.1963, 98 m, 1 spec. (disc only), (WAM).

ANATOMY: Unknown.

REMARKS: This species appears to occur in relatively shallow waters off tropical north eastern Australia and in deep water off south and central Western Australia. This seems to agree with other findings of a tropical fauna occurring in deep water of southern Western Australia (B. R. Wilson — pers. comm.).

Three species described by Chenu (1843) could be considered synonyms of this species.

Aspergillum ornatum Chenu, 1843. *Illus. Conch.*, 1, *Aspergillum*: 4, pl. 4, figs. 3 - 3a.

Aspergillum clavatum Chenu, 1843. *Illus. Conch.*, 1, *Aspergillum*: 4, pl. 4, figs. 4 - 4a.

Aspergillum incrassatum Chenu, 1843. *Illus. Conch.* 1, *Aspergillum* p. 4. pl. 4, figs. 2 - 2a - b.

These have no localities given and the types cannot be located in the British Museum. They only seem to differ from *B. (P). strangulatum* in having variously shaped protuberances over the valves. This form of growth is most probably an abnormal growth character and a large series showing this character would be necessary before these species could be confirmed. However, because of their lack of locality, these names were not included in the synonymy of the species.

Subgenus *Foegia* Gray, 1847

Foegia Gray, 1847, *Proc. Zool. Soc. Lond.*, 15: 188. Type species: *Aspergillum novaezealandiae* Lamarck, 1818 = *Penicillius novaezealandiae* Bruguere, 1789: (Monotypy).

Siphonal end simple, disc often indistinct, without fringe, umbos usually almost covered with swollen prominences.

Brechites (*Foegia*) *novaezealandiae* (Bruguere, 1789)

(Pl. 12, figs. 20, 21, 22, 23)

L'Arrosoire de la Nouvelle Zelande Favanne, 1780. *Conchyliogic* 1: 642, pl. 79, fig. E. (non. binom.) type figure.

Penicillius novaezealandiae Bruguere, 1789. *Ency. Meth.*, 1: 129.

Aspergillum novaezealandiae Lamarck, 1818. *H. N. Anim. sans Vert.*, 5: 430.

Aspergillum agglutinans Lamarck, 1818. *H. N. Anim. sans Vert.*, 5: 430.

Aspergillum novaezealandiae Lamarck, Chenu, 1843. *Illus. Conch.*, 1, *Aspergillum*: 3, pl. 3, figs. 6a, b, 7, 9.

Aspergillum agglutinans Chenu, 1843. *Illus. Conch.*, 1, *Aspergillum*: 3, pl. 3, fig. 2a.

Aspergillum novaezealandiae Lamarck, 1843. *Illus. Conch.*, 1, *Aspergillum*: 3, pl. 4, fig. 8.

Foegia novaezealandiae Gray, 1847. *Proc. Zool. Soc. Lond.*, 15: 188.

Foegia agglutinans Gray, 1858. *Proc. Zool. Soc. Lond.*, 26: 313.

Brechites agglutinans Adams, 1858. *Genera of Recent Molluscs*, 2: 339.

Brechites (*Foegia*) *novaezealandiae* Adams, 1858. *Genera of Recent Molluscs*, 2: 339.

Brechites (*Foegia*) *novaezealandiae* Adams, 1858. *Genera of Recent Molluscs*, 2: 339.

Aspergillum novaezealandiae Lamarck, Reeve, 1860. *Conch. Icon. (Aspergillum)* sp. 18.

Aspergillum agglutinans Reeve, 1860. *Conch. Icon. (Aspergillum)* sp. 18.

Penicillius (*Foegia*) *agglutinans* Smith, 1962. *Veliger*, 4(4): 173.

Penicillius (*Foegia*) *novaezealandiae* Smith, 1962. *Veliger*, 4(4): 173.

DIAGNOSIS: Disc small, of a tight cluster of tubules, fringe absent, anterior portion only slightly bulbous tapering to a narrow tube.

TYPE MATERIAL: The type was a figure in *Favanne* and no specimen of this can be found. No type specimen of *A. agglutinans* can be found in Paris or Geneva. Two syntypes of *A. novaezealandiae* are in the British Museum, BM(NH) Reg. No. 1968668. The type locality was described as New Zealand. However this is thought to be a mistake for the Swan River area of Western Australia (a not unusual error).

DISTRIBUTION: Recent only. The central and south-west coast of Western Australia and two specimens from the north coast of Queensland.

MATERIAL EXAMINED: WESTERN AUSTRALIA: South Passage, Shark Bay, 6.iii.1966, B. R. Wilson, 3-7 m in sand and weed, 1 spec. (WAM). Woods Point, Cockburn Sound, 26.xi.1967, G. W. Kendrick, 1 spec. (WAM); June 1958, B. R. Wilson, 1 spec. (WAM); 9.xi.1965, S. Slack-Smith, 4 spec. (WAM); 8.viii.1963, C.S.I.R.O. dredged 2-4 m 1 spec. (WAM); 24.vii.1965, G. W. Kendrick, 1 spec. (WAM). QUEENSLAND: Mapoon, C. Hedley 18 m, 1 spec. (AM). Sweers Is., 7.xii.1963, D. F. McMichael, 14-22 m, 1 spec. (AM).

ANATOMY: Unknown.

PLATE 12

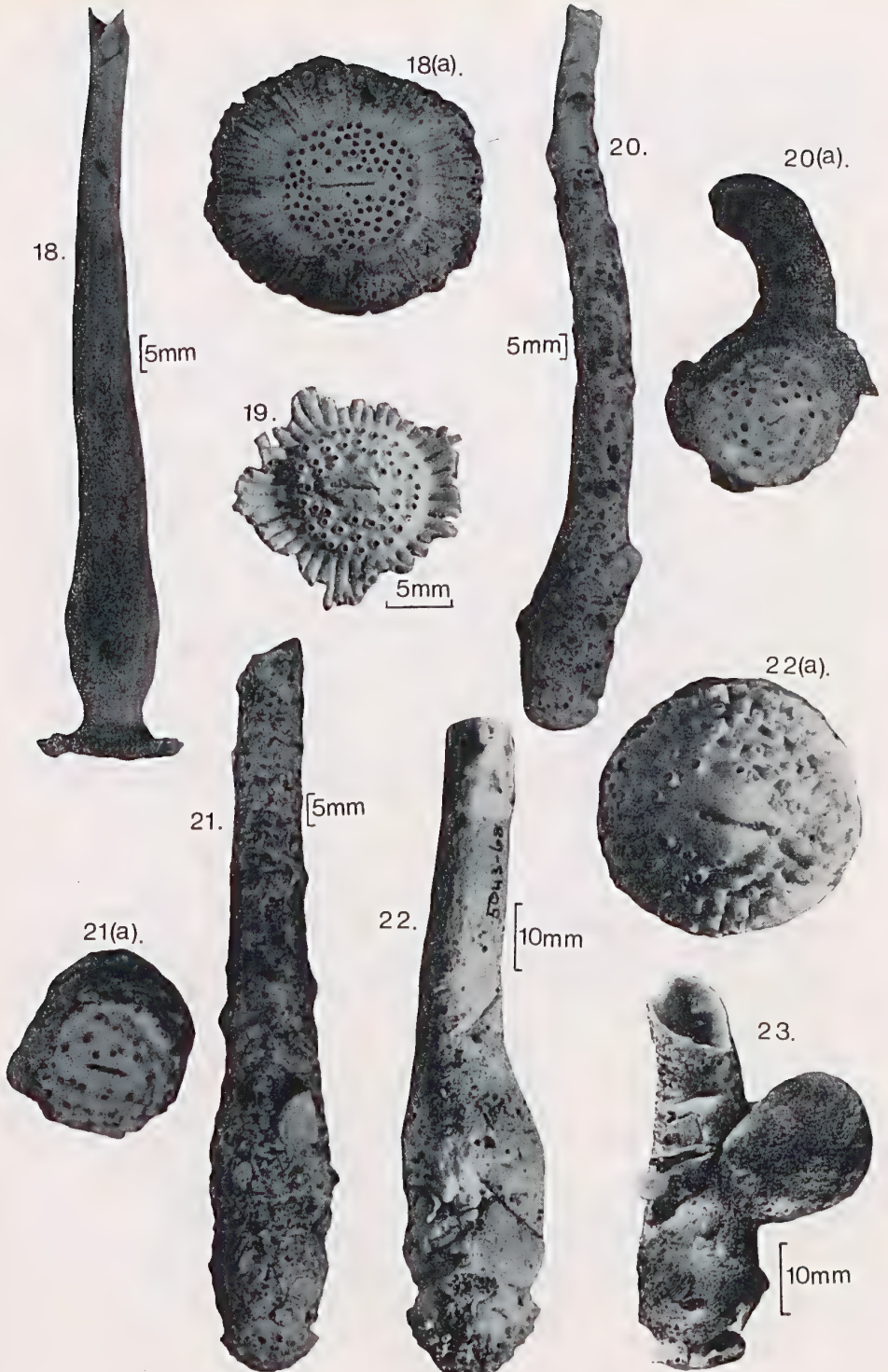
Fig. 18. *Brechites* (*Penicillius*) *strangulatus* (Chenu), BM(NH) 1841. 10.12.28, holotype, Port Essington, Northern Territory; (a) top view of disc.

Fig. 19. *Brechites* (*Penicillius*) *strangulatus*, 208-71, 144 m off Rottneest Is., Western Australia, top view of disc. (WAM).

Fig. 20-21. *Brechites* (*Foegia*) *novaezealandiae* (Bruguere), BM(NH) 1968668, two syntypes of *Aspergillum novaezealandiae* Chenu, Australia; (a) top views of discs.

Fig. 22. *Brechites* (*Foegia*) *novaezealandiae*, 202-71, Cockburn Sound, Western Australia, (a) top view of disc. (WAM).

Fig. 23. *Brechites* (*Foegia*) *novaezealandiae*, C74002, Sweers Is., Gulf of Carpentaria, Queensland (AM).



REMARKS: Both *A. agglutinans* and *A. novaehollandiae* are included here as synonyms because no specific differences could be found between them from the descriptions or published figures. It is however possible that if more specimens are discovered from Northern Australian waters, these may be found to differ from the southern forms, in which case either of these names could be available.

Brechites (Foegia) veitchi sp. nov.

(Pl. 13, figs. 24, 25, 26, 27)

Humphreyia incerta. Cotton, 1961. *South Australian Molluscs, Pelecypoda* p. 160, fig. 153. (not Chenu).

DIAGNOSIS: Shell large, anterior end greatly swollen, lacking a discrete disc; tubules covering bulbous portion except around valves; valves small, tending to become covered by swollen prominences, small anterior slit, small tube wide, circular in section, siphonal end simple.

DESCRIPTION: Shell large, consisting of a wide tube, circular in section, with a large, bulbous anterior end approximately twice the diameter of the tube and a third of its length. There is no discrete disc but the entire anterior end and the sides of the bulbous end away from the valves bear many short wide tubules each about 4 mm. long and 1 - 3 mm. in diameter. Both valves are small and fused with the tube just posterior to the centre of the bulbous anterior position. They are usually practically covered by overlapping anterior and posterior prominences. Shell fragments and stones are often attached to the anterior end and the shape of both the anterior bulbous portion and the tube is frequently distorted due to restriction of normal growth by large rocks and other obstructions in the environment.

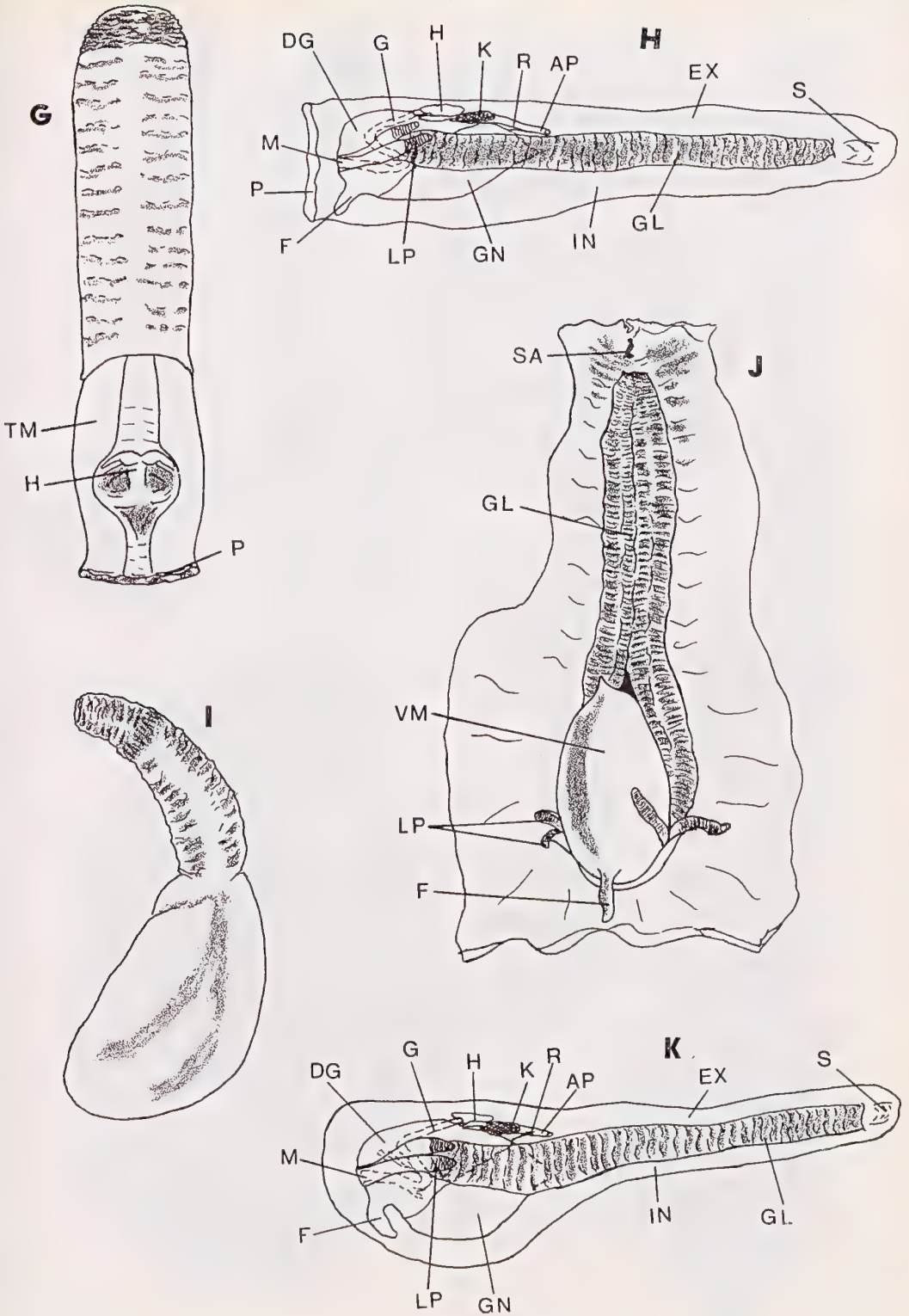
The animals consist of a large, bulbous, thick walled anterior part and a long, thick walled contractile tube, terminating in the two siphonal apertures.

TEXT Fig. G - K.

- G. Diagram of the dorsal view of the exterior of the animal of *Brechites (Brechites) australis*.
 H. Diagrammatic representation of the gross anatomy of *Brechites (Brechites) australis* from the lateral view.
 I. Diagram of the lateral view of the exterior of the animal of *Brechites (Foegia) veitchi* sp. nov.
 J. Diagram of the interior of the pallial chamber of *Brechites (Foegia) veitchi* sp. nov. from the ventral side.
 K. Diagrammatic representation of the gross anatomy of *Brechites (Foegia) veitchi* sp. nov. from the lateral view.

ABBREVIATIONS

a — auricle?	k — kidney
aa — anterior adductor muscle	lp — labial palps
ap — anal papilla	m — mouth (position of)
dg — digestive gland	p — pad of soft tissue
ex — ex-current chamber	pa — posterior adductor muscle
f — foot	r — rectum
g — gut	s — siphons
gl — gills	sa — siphonal aperture
gn — gonad	tm — true mantle area
h — heart	v — ventricle?
in — in-current chamber	vm — visceral mass



TYPE MATERIAL: Holotype in National Museum of Victoria, F27419, complete specimen with the animal preserved in 70% alcohol. Dimensions: Length (broken) 108 mm; diameters of the anterior end 50.0 mm x 50.0 mm.

Four paratypes: Paratype No. 1 in South Australian Museum, D14890, shell broken by dredge but animal preserved in 70% alcohol (used for dissection). Measurement impossible — shell broken. Paratype No. 2 and No. 3 in National Museum of Victoria, F27419, taken as dead shells with tubes broken; dimensions: No. 2 — tube broken; anterior end diameters 49.3 mm x 49.0 mm; No. 3 broken.

Paratype No. 4 in South Australian Museum, D14992, taken as a dead shell and originally figured as *H. incerta* by Cotton (1961), dimensions: Length — 167.5 mm; diam. of anterior end 47.5 mm x 38.5 mm.

Paratype No. 5 in South Australian Museum, D14993, dead shell, complete; dimensions: Length 226 mm; anterior end diameters 47.5 mm and 50.0 mm.

TYPE LOCALITY: All the type series were dredged by Mr. J. Veitch in 10 - 13 m, 0.4 km east of Snapper Rock, off Cape Donnington, near Port Lincoln, South Australia. Paratype No. 4 was taken in October, 1960. Paratypes No. 1, 2, 3 and 5 taken between 1962 and 1966. Holotype collected in January, 1967.

DISTRIBUTION: Lower Pleistocene and recent. *Fossil:* Roe Plains, Eucla Basin on Road to Hampton 53 km E. of Madura, W.A. *Recent:* From Spencer Gulf and the eastern part of the Great Australian Bight — off Port Lincoln and St. Francis Island.

OTHER MATERIAL EXAMINED: FOSSIL: WESTERN AUSTRALIA: Roe Plain, 53 km E. of Madura, Hampton, G. Gardner and A. Jones, June, 1970, 1 spec. (WAM — 70.1509). RECENT: SOUTH AUSTRALIA: Port Lincoln, J. Veitch, 3 spec. (Veitch Colln. — Port Lincoln). Spencer Gulf, J. C. Verco, 2 spec. (tubes only), (SAM). St. Francis Island, D. Howlett, 1 spec. (NMV).

ANATOMICAL NOTES: (Text figs. I - K). A preserved specimen (Paratype SAM — D 14890) and one from J. Veitch of Port Lincoln, S.A. were used for dissection. The holotype is preserved complete.

The animal has a very thick, muscular body wall over its entire body. The anterior part of the body is a swollen bag-shaped structure which fills the swollen anterior portion of the shell. Posterior to this is the long, tubular contractile portion terminates in short fused siphons. Near the anterior end in the mid-ventral region is a small pore, the vestige of the opening of the pallial cavity.

Internally the anatomy is similar to that of *Clavagella (Dacosta) australis* described above, except for the absence of adductor muscles. The visceral mass is large, egg-shaped, nearly filling the anterior portion of

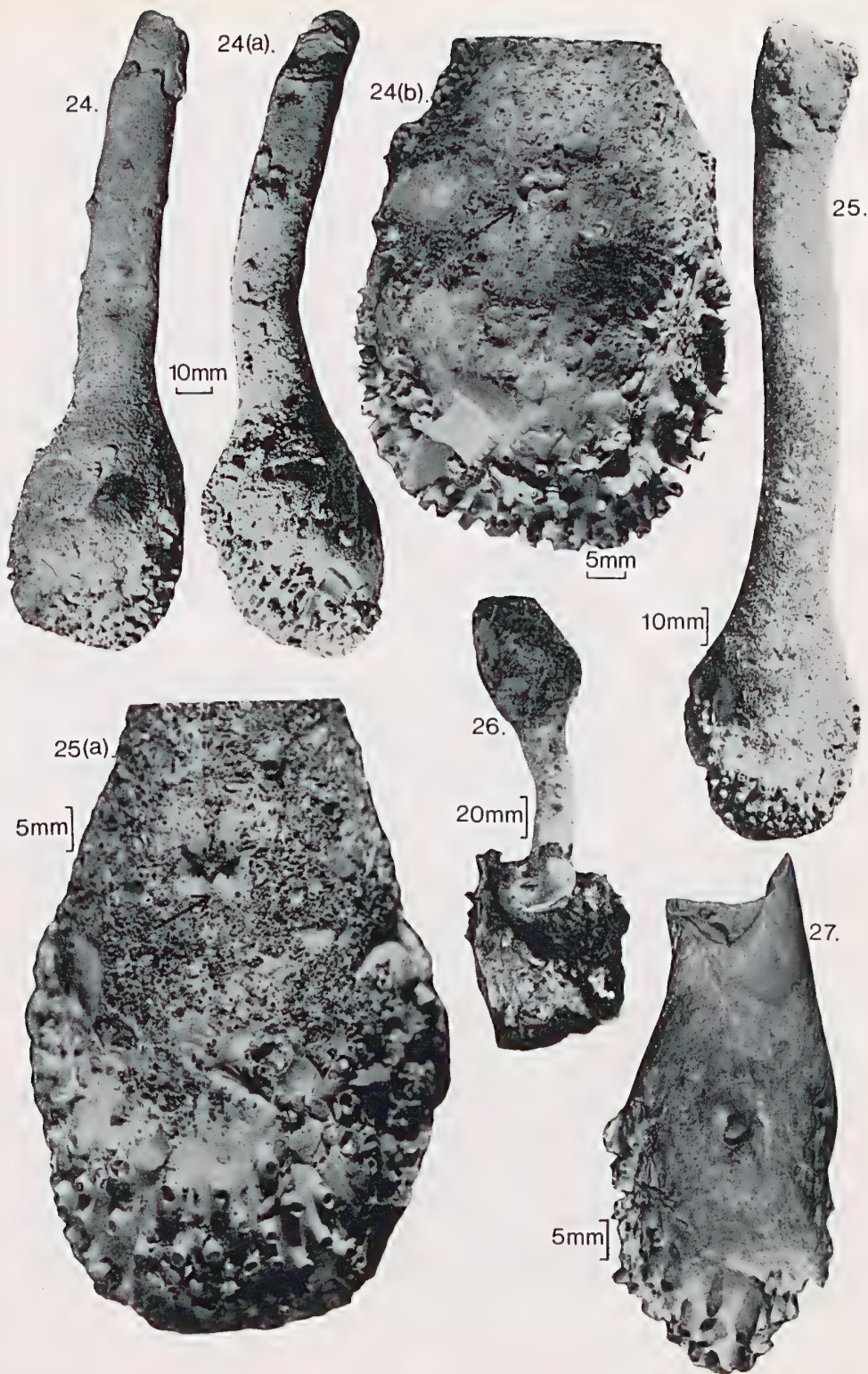
PLATE 13

Fig. 24. *Brechites (Foegia) veitchi* sp. nov., F27419, holotype, 11-13 m. off Cape Donnington, Port Lincoln, South Australia: (a) side view; (b) close-up of anterior end showing swollen prominences (arrowed) covering valves. (NMV).

Fig. 25. *Brechites (Foegia) veitchi* sp. nov., D14993, paratype; (a) close-up of anterior end showing valves (arrowed). (SAM).

Fig. 26. *Brechites (Foegia) veitchi* sp. nov., F27419, holotype showing specimen embedded in sponge.

Fig. 27. *Brechites (Foegia) veitchi* sp. nov., 70.1509, fossil specimen from Lower Pleistocene deposits on Roe Plain, Western Australia. (WAM).



the pallial cavity, and the large, finger-like foot protrudes from its anterior end (Text fig. J). The most striking structures in the pallial cavity are the large gills which commence from each side of the visceral mass as V-shaped demibranchs and fuse posterior to the visceral mass into a large W-shaped structure which extends nearly the entire length of the posterior, contractile portion of the body. The labial palps running laterally and posteriorly from the mouth to the anterior ends of the gills are also large, well-formed structures composed of many V-shaped filaments. A detailed description of the anatomy will be published elsewhere.

REMARKS: *Brechites (Foegia) veitchi* is easily distinguished from all other species by its large size and large bulbous anterior portion. The degree to which the valves are covered by the overgrowing protuberances of the tube is variable; in the holotype they are completely covered (Fig. 24b) while in some paratypes they are almost entirely exposed (Fig. 25a). The species also seems to vary from many other species of the genus in its mode of life. Most of the large species appear to live buried in a soft substrate with only the open end of the tube protruding into the water. However the holotype was dredged attached to a large sponge (*Ircinia irregularis* (Polejaeff), identified P. Bergquist) by the tube end, which was in turn attached to a large limestone rock. However this may be atypical in habitat. All the specimens are clean and free of growths although there is a young oyster, *Ostrea angasi*, on the side of the holotype. It is hoped that more ecological data will be obtained from divers in the near future. There is said to be (J. Veitch — pers. comm.) a small colony of the molluscs at the type locality.

It is also of considerable interest to record a specimen of this species from the Lower Pleistocene deposits of the Roe Plain, Western Australia. The specimen is obviously referable to this species although the anterior portion is not as swollen as any of the type series. The presence of this species in the Roe Plain fauna is another example of the similarity between this Lower Pleistocene fauna and the present fauna of the Great Australian Bight. (T. A. Darragh — pers. comm.).

The species is named for Mr. J. Veitch of Port Lincoln, who collected the type series, in honour of his very considerable contribution to the study of the mollusc fauna of Spencer Gulf and his assistance to the South Australian Museum and the National Museum of Victoria.

CONCLUSION

Although this study was confined to species found in Australian waters and fossil deposits, it was necessary to compare specimens with species found elsewhere. From this work it is evident that an intensive search through all the collections of the world followed by a critical worldwide revision of the family is necessary. There appear to be many names in the literature erected for abnormal growth forms and for first records for an area for no other reason than that the only similar species occurs many kilometres distant. The basic idea of recognising only three genera with many sub-generic groups put forward by Smith (1962a) was adhered to mainly because it was felt that too little material was available to undertake a redescription of the genera. However, there are many differences in specific and generic placement in this study and that of Smith, but because his revision gave no reasons for his actions a critical analysis is impossible.

Clavagellidae

The distributional data for all species in this family are insufficient and in many cases, there are gaps of hundreds of kilometres in the stated ranges. However, the distributions for living species, coupled with the many records of fossil specimens discovered in southern Australia, have caused considerable modification to the ideas of historical zoogeography for the family put forward by Smith (1962b). It is apparent that the family was present and widespread in Australia at a much earlier time than was previously thought, *Clavagella* s. str. being found fairly readily in Upper Oligocene deposits in Victoria and Tasmania and Pliocene deposits in South Australia, the latter deposits also containing *Humphreyia*. If Smith is correct in his assumption that the family originated in Europe in the Late Cretaceous, then the spread must have been very early and very rapid, probably in the Lower Oligocene. However, much more material is required to confirm this. The presence of this fauna in southern Australia also shows that this region should be included in any studies on the distribution of early Indo-Pacific faunas.

Little is known of the biology of these unusual bivalves, the only recorded observations on living animals being by Purchon (1956, 1960). From brief observations on the anatomy it is seen that both siphons open at the open end of the tube and that, therefore, in whatever position the shell lies, it must have the end of the tube protruding into the water. All the *Brechites* species most likely live buried vertically in a fairly soft substrate with only the end of the tube projecting into the water. However, some can live attached to rocks or other objects in the environment. For the animals that live buried, it would appear that Purchon's idea (1960) that the perforations in the disc are involved in the burying process by squirting water out through the holes, may be correct. However, this would not be the function of the perforations in the anterior end of *Clavagella* or *Humphreyia* species where many of specimens are found attached to dead shells or rocks by their anterior ends. The animals are believed to be filter-feeders using their very large, well-developed gills and labial palps to filter small suspended matter out of the water drawn into the in-current chamber, through the gills and out via the ex-current siphon. The ciliary current pathways on the gills, palps and the surfaces of the visceral mass and pallial cavity have been described by Purchon (1960) for *Brechites* (*Penicillus*) *penis* (L) and he also described the animals as ciliary feeders.

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ADDENDUM

The types of the following species were located in the collections of the British Museum (Natural History) by Dr. J. D. Taylor after this paper went to press.

Clavagella torresi Smith 1885. Holotype, Reg. No. 1887.2.9.2379.

Humphreyia coxi Brazier 1872. Holotype, Reg. No. 1904.5.10.74.

Aspergillum cumingianum Chenu 1842. Holotype, Reg. No. 19718.

Dr. Taylor notes that the Reeve (1860) figure of *A. cumingianum* resembles the type.